DISCUSSION OF THE AMENDMENT

Claim 1 has been amended to correct a spelling mistake, and by replacing "characterized in that" with the synonymous --wherein--.

The abstract has been amended by deleting language which may be implied.

No new matter has been added by the above amendment. Claims 1-12 remain pending in the application.

REMARKS

Applicants thank the Examiner for the courtesy extended to Applicants' attorney during the interview held December 12, 2002, in the above-identified application. During the interview, Applicants' attorney explained the presently-claimed invention and why it is patentable over the applied prior art, and discussed further how present Claim 1 should be interpreted. The discussion is summarized and expanded-upon below.

As recited in above-amended Claim 1, the present invention is a process for manufacturing a neutron absorbent material, said material being a composite material containing boron carbide and hafnium, comprising the following steps:

adding hafnium powder to a powder of boron carbide,

mixing the boron carbide powder and the hafnium powder such as to obtain a homogeneous mixture, and

sintering the homogeneous mixture at sufficient sintering pressure and temperature to obtain a composite material,

wherein the sintering pressure is applied before the temperature of the homogeneous mixture of the powders reaches the sinter reaction temperature of said mixture.

The significance of the limitation following the word "wherein" is described in the specification at page 9, lines 13-27, as follows:

> Sintering pressure may be applied before the reaction which occurs in the mixture of the boron carbide and hafnium powders. Therefore, the pressure may be applied before the temperature of the powder mixture reaches the sintering reaction temperature of said mixture, for example when the temperature of the mixture and the mould is approximately 20 to 1200°C, for example around 500 to 1000°C, or further at approximately 800°C for example.

The significance and superiority of this embodiment is demonstrated in Example 2, beginning at page 14, penultimate line, of the specification. A composite material was obtained using different sintering cycles and at different temperatures as shown in Table 1 at page 16 of the specification, and reproduced below:

<u>Table 1</u>

Sintering temperature in °C		1000	1200	1300	1400	1800	1900	2000
Pressurizing at sinter temperature and sintering pressure of 60 MPa	rd as %	58	60	61	-	67	-	70
Pressurizing at sinter temperature and sintering pressure of 110 MPa	rd as %	-	65	-	68	-	80	83
Pressurizing at 800°C and sintering pressure of 92 MPa	rd as %	-	68	69	-	85	-	99

As described in the specification at page 16, lines 3-10, Figure 1 graphically plots the values of Table 1. As Applicants describe at page 16, lines 11-14 of the specification, the figure shows the influence of the sinter cycle parameters on the sintering temperature of a mixture of boron carbide and hafnium according to the invention. Applicants then describe, in the specification at page 16, line 15, through page 17, line 7, the following:

> The results of this example generally show that the temperature at which pressure is applied to the mixture may be essential to obtain the composite of the

invention having relative densities varying between 80 and 99% of the theoretical density of the initial mixture after reactive sintering.

Different composite materials of the invention were analysed by X-ray diffraction. These composite materials were obtained with pressurization at low temperature and a sintering pressure of 92 MPa for increasing sinter temperatures: 1000°C, 1200°C, 1400°C, 1800°C, 1900°C and 2000°C. Analysis of X-ray diffraction spectra made it possible to follow the changes in the chemical composition of the composite of the invention in relation to sintering temperature. With this analysis, the different phases present in the composite of the invention could be identified in order to obtain the most favourable chemical composition for improved performance under neutron radiation.

Applicants summarize the results at Table 2 of the specification at page 17, reproduced below:

Table 2

Sinter temperature in °C	Type of phases present in the composite material of the invention
1000	Boron carbide B_4C Hafnium Hf Hafnium monoboride HfB Hafnium carbide HfC Hafnium diboride HfB_2
1200	Boron carbide B_4C Hafnium Hf Hafnium diboride HfB_2 Hafnium monoboride HfB Hafnium carbide HfC Carbon C
1400	Boron carbide B_4C Hafnium diboride HfB_2 Hafnium monoboride HfB Hafnium Hf Hafnium carbide HfC Carbon C
1800	Boron carbide B_4C Hafnium diboride HfB_2 Hafnium monoboride HfB Carbon C traces: Hafnium Hf Hafnium carbide HfC
1900	Boron carbide B_4C Hafnium diboride HfB_2 Carbon C traces: Hafnium monoboride HfB
2000	Boron carbide B_4C Hafnium diboride HfB_2 Carbon C

Applicants then describe in the specification at page 18, lines 2-12, the following:

> These results show in particular that a temperature of 1800°C must be reached to obtain a composite material associating the advantages of a boron carbide phase and hafnium diboride phase.

These results generally show that, at the outset, when the conditions of thermal contact between the two boron carbide and hafnium phases in the initial mixture of powders are in accordance with those of the present invention, a set of chemical reactions occurs during sintering which involves changes in the chemical composition of the material of the invention.

The above-discussed data shows that the parameters of the sintering cycle and the sintering temperature affects the properties and chemical make-up of the composite material formed.

The rejections under 35 U.S.C. § 102(b) of Claims 1-5 and 12 as clearly anticipated by U.S. Patent No. 5,242,622 (Boutin et al), and of Claims 1, 4-6, 8 and 12 as anticipated by JP 61-77794 (Genshi), are respectfully traversed.

Boutin et al discloses a process for the production of a neutron-absorbing pellet comprising mixing electrolytic crystals or chips of hafnium and optionally boron carbide powder, compressing the mixture in a mould, and optionally carrying out a sintering treatment. Boutin et al neither disclose nor suggest the presently-claimed invention since compression, presumably carried out in Boutin et al at ambient temperatures, since no temperatures are disclosed, and sintering, are carried out sequentially.

Genshi discloses a burnable cermet-type poison pellet composed of boron carbide and a metal which may be, *inter alia*, hafnium, obtained by press-molding under pressure a mixture of boron carbide and metal powders, and subsequently sintering at 1600°C in an atmosphere of argon-hydrogen for 30-60 minutes.

There is, in effect, no "sintering pressure" applied in Boutin et al or in Genshi, as that term would be understood herein, based on the description at page 15, lines 12-13, of the specification. Nor could one skilled in the art reading Boutin et al or Genshi have predicted the above-discussed results when employing the presently-claimed sintering embodiment.

The Examiner indicated during the above-referenced interview, as indicated in the Interview Summary, that the present claims are inclusive of sintering at atmospheric pressure. In reply, Applicants respectfully submit that while claims are to be given their broadest reasonable interpretation consistent with the specification, the Examiner's interpretation is **not** reasonable. Since it is at least implicit from the term "sintering pressure" that pressure is applied, it is clear that simply sintering the homogeneous mixture at atmospheric pressure would not lead to the recited composite material. Moreover, even if the Examiner's interpretation were correct, the claims would still be patentable over the applied prior art, which discloses sequential compression (or molding) and sintering, while the present claims recite sintering under pressure.

Claim 12 is also patentable over the applied prior art, since the above-discussed comparative data shows that the product claimed therein would be different than one obtained by the processing regime of either Boutin et al or Genshi.

For all the above reasons, it is respectfully requested that the rejections over Boutin et al or Genshi be withdrawn.

The objection to the abstract of the disclosure is now moot in view of the above-discussed amendment. Accordingly, it is respectfully requested that it be withdrawn.

Applicants gratefully acknowledge the Examiner's indication of allowability of Claims 7 and 9-11. However, Applicants respectfully submit that all of the presently-pending claims in this application are now in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.

Norman F. Oblon
Attorney of Record
Registration No. 24,618

Harris A. Pitlick
Registration No. 38,779

22850

(703) 413-3000
Fax #: (703)413-2220
NFO:HAP:kst

I:\atty\HAP\213252us-am.wpd

Marked-Up Copy
Serial No: 09/926,100
Amendment Filed on:
Herewith

IN THE CLAIMS

--1. (Amended) Process for manufacturing a neutron absorbent material, said material being a composite material containing boron carbide and hafnium, comprising the following steps:

- adding hafnium [power] powder to a powder of boron carbide,

- mixing the boron carbide powder and the hafnium powder such as to obtain a homogeneous mixture, and

- sintering the homogeneous mixture at sufficient sintering pressure and temperature to obtain a composite material,

[characterized in that] wherein the sintering pressure is applied before the temperature of the homogeneous mixture of the powders reaches the sinter reaction temperature of said mixture.--

IN THE ABSTRACT OF THE DISCLOSURE

(New)